In support of progress in the design and development of the SOFIA telescope, the nonspecular reflectometer (NSR) at Ames was reactivated and upgraded, enabling the NSR to be used to measure infrared reflectance properties for samples of planned SOFIA telescope system structural materials and associated surface treatments. Measurements of specular reflectance and bidirectional reflectance distribution functions (BRDFs) were made at wavelengths from 2.2 to 640 microns, at two angles of incidence, and at scattering angles as far as 85 degrees from normal. Samples of planned telescope system materials included carbon fiber reinforced plastic (CFRP), insulating foams, and Nomex fabric. Samples of candidate surface treatments for focal-plane instruments included two commercial surface treatments and several samples prepared at Ames with black paints and other components. The commercial surface treatments investigated were "Optoblack," a paint-like surface treatment from Labsphere, Inc. (North Sutton, New Hampshire), and "Vel-Black," a carbon fiber applique from Energy Science Laboratories, Inc. (San Diego, California). In general, the samples of telescope structural materials appear to have acceptable far-infrared reflectance and scattering properties, even compared to surface treatments expressly developed to minimize such effects. Figure 1 shows specular reflectance results for the telescope samples, compared to infrared-optimized black paints. The commercial surface treatments appear to have excellent characteristics for use in the far infrared. Samples prepared at Ames performed well when silicon carbide grit was mixed in. These Ames-prepared samples approached but did not equal the performance of more carefully developed infrared black paints such as Ames 24E2 and Ball Infrared Black (BIRB).

These empirical results can now be incorporated into a software model of the SOFIA telescope, which would provide predictions of likely infrared background noise levels. However, it appears already possible to conclude from the results of the work described that the surfaces evaluated will probably not contribute significant infrared stray light.

Point of Contact: A. Meyer
(650) 604-1612
ameyer@mail.arc.nasa.gov

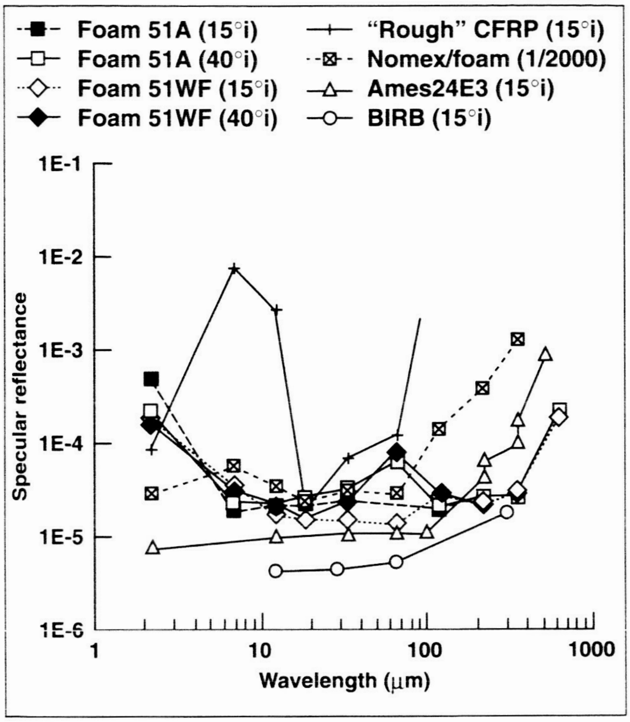

Fig. 1. Surface treatment samples measured by the NASA Ames nonspecular reflectometer, including infrared reflectance spectra for samples of Rohacell white foam, roughened CFRP, Nomex over melamine foam, and, for comparison, previously published data for the black paints Ames 24E2 and BIRB.

Identification of Nitriles in the Interstellar Medium

Yvonne J. Pendleton

The interstellar 4.62-micron band (2165 wavenumber) may be an important contributor to the cyanide (CN) inventory of material available for incorporation into newly forming planetary systems. This band is seen in absorption along lines of sight that pass through icy grains in front of embedded protostars. Therefore, the identification of the interstellar band is important for two reasons: for the astrophysical understanding of organic material in the dense cloud environment, and for the potential relevance to the origin of life, because extraterrestrial sources of CN groups may have been necessary if the early Earth had a nonreducing environment.

New laboratory results indicate that carbon, nitrogen, oxygen, and hydrogen are active participants in the carrier of the interstellar 4.62-micron band. Results show that ion bombardment of interstellar ice analogs readily produces a band in laboratory residues that is remarkably similar in profile and peak position to that seen in the dense interstellar medium. A shift in band position resulting from deuterium substitution demonstrates that hydrogen is a component of the carrier in the laboratory-produced 4.62-micron band. This finding is in contrast to premature identifications of the isocyanate anion, OCN^-, published recently by other groups. Irradiation of ices through ion bombardment allows testing mixtures that include solid nitrogen, N_2, a possible source of the available nitrogen in dense cloud ices. If the atmosphere of the early Earth were not overly reducing, as some studies indicate, extraterrestrial sources of CN-bearing molecules may have been necessary for the origin of life, the *in situ* production of prebiotic molecules containing the cyanogen bond would have been difficult. Therefore, the identification of the interstellar 4.62-micron band may include the identification of an extraterrestrial source of CN.

Point of Contact: Y. Pendleton
(650) 604-4391
ypendleton@mail.arc.nasa.gov

Identification of Hydrocarbons in the Diffuse Interstellar Medium

Yvonne J. Pendleton, Louis J. Allamandola

Of relevance to both astrophysics and astrobiology is the nature and evolution of organic material in the interstellar medium (ISM), because the "final" material available for incorporation into planetary systems will determine, in part, the composition of primitive planetesimal bodies, including those capable of delivering organic material to planets within habitable zones. One interstellar feature of primary relevance, the 3.4-micron hydrocarbon absorption band, has been the focus of a recent investigation into the origin and evolution of the carbonaceous component of the diffuse ISM. The remarkable similarity of the interstellar 3.4-micron band to that seen in the extract of carbonaceous meteorites has further spurred the interest in the origin of the $-CH_2-$ and $-CH_3$ groups that result in the interstellar band.

Organic residues created in the laboratory, through the energetic processing of ice mixtures and through electric discharge experiments on hydrocarbon plasmas, have resulted in many claims of spectral matches to the interstellar 3.4-micron band. The laboratory work has been essential in revealing much about the nature of the carrier, and there is consensus that the interstellar band arises from saturated aliphatic hydrocarbons. However, the exact identity of the species responsible for the interstellar band has not yet been revealed. In an effort to further constrain the properties of the true carrier of the interstellar bands, the 3.4-micron laboratory band has been investigated further through the compilation of a database of hydrocarbon candidates from astrophysics laboratories around the world. The laboratory candidates have been compared in detail over the 2- to 9-micron range to the interstellar data from ground-based, airborne, and space observations. Many candidate materials can now be ruled out on the basis of constraints placed upon them from the interstellar data. The interstellar line of sight used in this comparison is toward a star that lies behind the primarily diffuse interstellar medium dust; therefore, contributions from dense molecular cloud ices are insignificant. The Infrared Space Observatory has provided a comprehensive view of this sight line, and it reveals the absence of any strong absorption bands in the 5- to 8-micron portion of the interstellar spectrum. The upper limit of the hydrocarbon bands in the 5- to 8-micron region to those detected at 3.4 microns provides useful constraints upon the laboratory residues. Most of the laboratory residues yield large absorptions in the 5- to 8-micron region, especially those produced through the processing of ices. The most likely candidates remaining are those produced through plasma processing of hydrocarbons. This finding is consistent with recent reports of the 3.4-micron hydrocarbon absorption detected in